

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of)	
)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services)	GN Docket No. 14-177
)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands)	IB Docket No. 15-256
)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band)	
)	RM-11664
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services)	
)	WT Docket No. 10-112
)	
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations)	IB Docket No. 97-95
)	

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September 10, 2018

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I. Introduction and summary

A. Background.

Intel Corporation and Cisco Systems, Inc. (“Joint Commenters”) respectfully submit this comment to the Commission’s Third Further Notice of Proposed Rulemaking¹ on the use of spectrum bands above 24 GHz for mobile radio services. This comment builds upon, and makes certain modifications to, the proposal submitted by Intel Corporation in its 2016 FNPRM comments², for the coordinated, shared use of the 37-37.6 GHz band (the Lower 37 GHz Band). Our comments are limited to topics related to the Lower 37 GHz band. The Joint Commenters consider the Commission’s proposal in this FNPRM, while taking into account rules adopted in the initial Report and Order³ as well as the Third Report and Order. In its prior decisions in this docket, as well as in the Third FNPRM, the Commission has remained consistent in its view that the 37-37.6 GHz band should be promulgated as an “innovation band” with licensing rules different from millimeter wave rules adopted for more traditional exclusive licensed or unlicensed bands. Here, the Commission is looking to create rules for “fixed and mobile terrestrial operation”⁴ in a band that is co-equally shared between Federal and non-Federal users based on non-exclusive site-licensing, where non-Federal users are licensed by rule, and that facilitates future

¹ *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, Third Report and Order, Memorandum Opinion and Order, and Third Further Notice of Proposed Rulemaking, GN Docket No. 14-177, released June 8, 2018 (hereinafter “Third R&O” or “Third FNPRM” as applicable).

² Comments of Intel Corp, GN Docket No, 14-177, at 3-13 (filed Sept 30, 2016).

³ *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, Report and Order and Further Notice of Proposed Rulemaking, GN Docket No. 14-177, 31 FCC Rcd 8014 (2016) (“R&O” or “FNPRM,” as applicable).

⁴ Third FNPRM ¶59.

Federal expansion, promotes access by a wide variety of entities, support innovative uses, facilitate low-cost access, and provides targeted access where and when providers need additional capacity.⁵

Given that the Commission's objective of creating an innovation band remains unchanged⁶, the Joint Commenters wish to present a view of how the Commission's proposal, including rules already adopted, could be implemented with the greatest benefit to all stakeholders, and to the national economy, as well. Our views are informed by our technology expertise, as well as by our deep understanding of 5G networks, including the requirements for the use of wireless technologies to enable automation and machine-to-machine communications, which will drive the digitalization of business practices in the industrial, public, and enterprise sectors of the national economy.

B. Band characteristics influence licensing scheme.

The Joint Commenters proposal is a direct result of our understanding of radio propagation in the spectrum at 37 GHz, the anticipated growing use of millimeter wave spectrum as part of 5G networks, as well as the widespread recognition of the need for private wireless networks that can take advantage of the latest technologies to deliver the benefits of, for example, machine-to-machine communications (the Internet of Things). The lower 37 GHz band, due to its propagation characteristics, has important differentiating properties relative to lower bands, *e.g.* below 6 GHz. For example, compared to lower frequency bands it is more challenging to provide reliable wide area coverage outdoors, but easier to operate and contain signals indoors as these tend to reflect off walls or windows, and thus do not reliably provide "outside - in" wireless coverage. Stating it in simple terms: buildings,

⁵ R&O ¶¶112, 113

⁶ Third FNPRM ¶63.

building walls, and intervening clutter/obstructions play an elevated role in defining wireless coverage areas for this regime. As such, the lower 37 GHz band is unlikely to be exhaustively licensed on a widespread geographic basis in the same way that sub-6 GHz frequencies are.

C. Site licenses fill an unmet need.

In the intervening years since the 2015 NPRM was published, much more is known about demand for millimeter wave technologies. In the view of the Joint Commenters, demand exists for new, more robust private wireless networks to address business-critical, mission-critical, and enterprise/industrial automation use that is projected to have significant economic benefits for the national economy.⁷ Whether this is called the “Industrial IoT,” the “next industrial revolution” or “Industry 4.0,” empowering enterprise processes with wireless transmission of data is becoming a critical piece of national economic strategy for competitiveness throughout the world. While these private wireless networks might be operated in various ways, such as adjuncts to carrier “5G” networks, CBRS networks or even (in some cases) using unlicensed spectrum, there are and will be numerous use

⁷ There are any number of analyses that support this proposition. See (1) <https://www.qualcomm.com/invention/5g/private-industrial-networks> ; (2) https://www.multefire.org/wp-content/uploads/HRI_Paper_Private-LTE-Network-Paper_20-July-2017_Final.pdf ; and (3) <https://www.lightreading.com/mobile/5g/the-emergence-of-private-lte-networks/a/d-id/734418>. In Europe, a trade group has recently been formed to advocate for private wireless solutions in enterprise. <https://www.fiercewireless.com/wireless/5g-acia-kicks-off-to-focus-industrial-uses>.

cases that require “deterministic”⁸ use of spectrum – specifically, creating certainty for use cases where an enterprise/industrial user needs to control and manage the radio spectrum without reliance on an external party. Still other enterprise/industrial users may prefer to utilize a service provider offering and utilizing the spectrum according to the terms of the service provider’s offer. That said, the established licensing framework for this band enables spectrum that the entity can manage and control itself, and could not only lead to additional innovation in how the spectrum will be used, but also can support applications that must perform to an extremely high quality of service and availability level without encountering harmful RF interference. It should also be noted that certain Federal users may have similar requirements to non-Federal users on service quality and availability.

Unlicensed spectrum (such as that available at 57-71 GHz) does not permit an enterprise/industrial user to sufficiently manage these attributes of the spectrum because anyone with a Part 15 device can transmit in the band, even while on the business premise. The lower 37 GHz band offers the potential to uniquely serve the needs of both Federal and privately owned or managed wireless networks.

Regulation should support, or at a minimum not bar, innovation in business models. Enterprises themselves, third parties on behalf of enterprises, and traditional service providers may wish to participate in the site licensed opportunity in the band, and there should be no barrier to utilizing whatever business model a potential licensee seeks. As a result, we believe there is value in the Commission’s flexible approach to the lower 37 GHz band services, to enable all interested parties to participate in using the band.

⁸ By “deterministic”, we mean that all sources of performance-impacting interference are under the control of the network owner.

D. Co-equal sharing between Federal and non-Federal users.

With co-equality between Federal and non-Federal users as a stated objective in the Lower 37 GHz band⁹, Federal users should not generally be capable of asserting priority access rights, nor preempting non-Federal users (as would be the case in bands adopting primary spectrum rights for Federal users). Homogeneity in the sharing rules for Federal and non-Federal users makes successful sharing more likely, but there may be narrow exceptions such as Federal priority *e.g.* on military installations.

E. The 70/80 GHz band provides a successful model for sharing in this band.

Beginning from the aforementioned rules already in place, we propose the use of a straightforward, streamlined sharing framework fashioned after the proven successful 70/80 GHz model with appropriate modifications specific to this band. Individual licensees themselves (or via a third-party service), would coordinate site licenses with geographically adjacent licensees prior to filing, including the equitable partitioning of channels if other methods (e.g. shielding, power reductions, antenna modifications, etc.) are not available to avoid interference among adjacent or overlapping site licenses. The record of Commission Orders in the 70/80 GHz proceeding provides an effective and detailed template from which to expeditiously create rules for the Lower 37 GHz band.

F. Polygons are the most practical license area geometry.

In general, we expect the site licenses to be licensee-defined clusters of base stations/access points with a circumscribed polygon¹⁰ as the service area boundary for licensing purposes. We believe

⁹ See 47 CFR §30.7. See also R&O ¶¶18,102,113,145 and FNPRM ¶¶448, 449.

¹⁰ In some situations, the license boundary polygon may need to be augmented by surfaces above and/or below the polygon, which define the vertical extent of the site license volume (e.g., should the license only apply to a

this polygon approach to be a more flexible and practical license boundary definition than the point-radius circular or site-cluster licenses the Commission has proposed in this Third FNPRM.¹¹ Note that a circular license area could be replicated with a polygon (*e.g.* approximated by an octagon or other n-sided equilateral polygon) if desired.¹²

G. Two license categories (General Site and Property Zone) are recommended.

We propose two administrative categories of site licenses: General Site (GS) and Property Zone (PZ) licenses. Within either category, licensees may deploy point-to-point, point-to-multipoint, or other configurations. It is the polygon representing emission boundaries that serves as the coexistence reference line, and the interior of the polygon could contain any configuration of network elements so long as the emissions requirements at the emission boundary are met.

H. Property Zone license description.

The PZ license would be defined by the polygon representing the real property boundary of a given property-owner licensee (in other words, a distinguishing attribute of a PZ license is that the licensee has a pre-defined license boundary to work within, as its starting point, and must ensure any network elements it deploys will meet the emission limits at the property boundary). Under the rules

subset of floors within a multi-story building). Where appropriate, these surfaces might also represent emission boundaries.

¹¹ Third FNPRM ¶72.

¹² A circular license area (or a circle approximated by a polygon) might be used for example in an outdoor deployment where transmitters do not encounter clutter or obstructions. For indoor use, or outdoor use in the presence of clutter or obstructions, a polygon permits greater flexibility in defining a boundary that is better matched to the desired coverage area. A polygon also permits better boundary matching between adjacent licensees without overlap.

already adopted, a real property owner¹³ would be able to register and operate a site defined by its property boundary even if the PZ license category did not exist. However, we believe the creation of this category of license has advantages in the operational efficiency of the sharing framework. We also note that the PZ license category is not a revival of the Commission’s hybrid plan proposed in the NPRM. The hybrid plan was based upon county-size exclusive licenses obtained via competitive bidding, with shared use imposed on license holders to accommodate site licenses by other entities, including property owners. Here, the rules preclude exclusive licenses in favor of non-exclusive site licenses. Thus, the numerous complaints and complexities voiced in the comment record regarding the hybrid plan’s encroachment of legitimately obtained exclusive rights do not apply to this proposal for the Lower 37 GHz band.

I. Property Zone licenses are also suited to Federal users.

In the case of Federal use, and Federal users, authorized site areas may generally align with the PZ (Property Zone) license category. The National Telecommunications and Information Administration (NTIA) may wish to consider a more automated process that easily allows it to determine existing agency “licenses” in the band, along with spectrum assigned, and to seamlessly interface with the sharing framework for non-Federal users.

¹³ We will use the term “real property owner” to mean any person or entity with an interest in real property, owned or leased. This would include government locations owned or leased. Given the licensing and coordination requirements of the band, including the desire to maintain a well-controlled interference and access environment, we would expect that users would be limited to enterprise, government or service provider interests, as consumers would not be in a strong position to prosecute and maintain a license. Consumers have access to 14 GHz of millimeter wave spectrum in the Part 15 unlicensed 60 GHz band.

J. Indoor-only use could further expedite the authorization process.

The Joint Commenters believe that the propagation characteristics of the lower 37 GHz band, under the framework we are advocating for, allow comparatively easier delineation between indoor vs outdoor use and geographically adjacent use, relative to lower frequencies. In fact, a licensee (for example, a PZ licensee implementing factory automation only in the interior space of its facility) could choose to limit its operations to indoor-only, validate that it meets emissions requirements along the property perimeter, and expect a swift authorization while facing few if any co-existence issues for future geographically-adjacent licensees.

K. General Site licenses provide greater user flexibility in license area.

In contrast to the PZ license category with its boundary defined by the pre-existing property boundary, the GS license would be a licensee-defined polygon that ideally would not geographically overlap any other licensee. However, overlapping polygons are not prohibited, and perhaps could be common for GS licensees. The coordination efforts in such cases could be more complex, particularly if the licensees also overlap in the frequency domain. The existence of the GS category will encourage spectrum to be deployed, especially in areas where PZ licensing take up rates are low.

L. Licensees should, by rule, accommodate other licensees.

With respect to overlapping requests to authorize frequencies or channels in geographic proximity, or next-in-time license proposals overlapping a prior license, coordination by all users should *by rule* accommodate the competing use *to the extent feasible*.¹⁴ To that end, radios would also be

¹⁴ By feasible, the Joint Commenters refer to situations where, for example, licensees can avoid co-channel operations via negotiated split of the six available channels, or one could agree to accept interference from another, or adjust power levels, re-orient antennas, or other technical means to achieve equitable coexistence.

required to tune through the entire 600 MHz so that licensees can move between the six available 100 MHz channels as fungible channels,¹⁵ in order to facilitate coexistence in cases of geographically adjacent operations. Given that the single class of non-exclusive non-Federal licensees is co-equal to Federal users, the rules should obligate geographically-proximate licensees (both Federal and non-Federal) to bargain to accept interference, swap channels, adjust or change antennas and power levels, and other mutually agreeable means of facilitating coexistence. If necessary, the Commission could provide guidance for resolving coexistence issues and bandwidth sharing. In bargaining, the NTIA could act as proxy for federal users, in cases where co-equal federal and non-federal users are geographically proximate.

M. License terms and conditions.

Licensing fees should be kept at a modest level, to encourage easy entry, and coordination costs (in the case of 3rd party coordinators) would be subject to competitive market forces. To align with the rules governing licenses in the upper 37.6-40 GHz portion of the band, we also propose a ten year license term with renewal expectancy for these Lower 37 GHz licenses. This would include an annual automated, “check in” with the Commission, for the purpose of validating continued operations, and should represent a minimal burden and provides some protection against warehousing spectrum. It also creates a predictable cadence for license discontinuance if check-ins are not processed because systems have been abandoned.

¹⁵ It is possible that the top 100 MHz channel (37.5-37.6 GHz) in this band may have adjacent channel interference considerations with the bottom channel in the 37.6-38.6 GHz exclusive licensed band, if deployments are in close geographic proximity. The Commission would have to address coordination requirements in such cases.

II. Co-equal sharing framework for the 37-37.6 GHz band.

A. Shared operations in the 37-37.6 GHz band are a function of the rules promulgated in the Report and Order.

In its 2016 Report and Order the Commission created a shared band in the 37-37.6 GHz portion (the lower 37 GHz band), and has ruled (and re-affirmed its rules following challenges via Petitions for Reconsideration) that it will be:

- 1). Licensed on a non-exclusive basis.¹⁶
- 2). Co-primary, co-equally shared between Federal and non-Federal fixed and mobile users.¹⁷
- 3). Non-Federal users will be licensed-by-rule¹⁸ using site licenses¹⁹ wherein individual base stations and access points must be registered and frequency-coordinated prior to operation.²⁰
- 4). The lower 37 GHz band consists of six contiguous 100 MHz channels.²¹

The Third FNPRM seeks to develop a sharing framework for assigning frequencies to site-licensed users (both Federal and non-Federal), and draws a distinction for point-to-point and individual base station licenses, given these conditions. In its initial Report and Order, the Commission noted, “it is in the public interest to license [the lower 37 GHz band] on a non-exclusive shared basis.”²² The Commission also stated that its objectives for the lower 37 GHz band are to facilitate future Federal expansion, and to promote access by a wide variety of entities, support innovative uses, facilitate low-cost access, and targeted access where and when providers need additional capacity.²³ With this

¹⁶ R&O ¶112

¹⁷ R&O ¶¶111, 113

¹⁸ R&O ¶113

¹⁹ R&O ¶121

²⁰ R&O Appendix A, § 30.7 (c)

²¹ Third R&O ¶28

²² R&O ¶112

²³ R&O ¶¶112, 113

starting point in the rules set by the 2016 Report and Order, we propose a site licensing regime with a coordination framework, below.

B. A straightforward, streamlined coordination framework is appropriate for the Lower 37 GHz Band.

Given the straightforward initial sharing environment²⁴ with few Federal incumbents and no non-Federal incumbents, the coordination framework for this Lower 37 GHz Band can and should be as simple and streamlined as is feasible. A complex coordination framework, *e.g.* one modeled after the 3.5 GHz Spectrum Access System (SAS), is neither necessary nor recommended since this band lacks the numerous complications and special considerations present in the 3.5 GHz band, and the band (Federal and non-Federal) users have co-equal rights rather than prioritized tiers of use.²⁵

Under the site licensing regime specified for this band, the Joint Commenters recommend polygons as the most flexible geographic configuration for site licenses, where the polygon surrounds a cluster of networked mmW base stations/access points, including point-to-point links, and represents the emission boundaries of the service area. The polygon would be specified by the site licensee using geographic coordinates and would be subject to coordination. The comparatively limited propagation and penetration characteristics of mmW frequencies could make such licenses useful for licensing over local areas, although it might be feasible to extend the network more broadly, or chain together adjacent site licenses, depending upon intensity of use. As noted in the Introduction, Joint Commenters believe polygon license areas are more flexible and adaptable than the circular point-radius

²⁴ FNPRM ¶449

²⁵ In addition the viability of sensing networks (such as those deployed in the CBRS band) is very different given propagation characteristics of the RF signals at 37 GHz compared to 3.5 GHz, as well as transmit powers and geographic distribution.

configuration proposed in the Third FNPRM (and can replicate circular areas as well). As also noted in the introduction, Joint Commenters propose two *categories* of polygon-based site licenses: General Site (GS) licenses and Property Zone (PZ) licenses, where the latter is strictly applicable to the property boundary of e.g. an enterprise/industrial user or Federal user. These categories of site licenses are discussed in more detail in later sections.

Below we propose a sharing framework which meets the aforementioned objective of being straightforward and streamlined, and that uses polygons as the geometry for defining site license boundaries.

C. The Commission should use an established sharing framework as a model for the lower 37 GHz band, and should require existing licensees to accommodate prospective licensees to the extent feasible.

Registration and Coordination Framework. For the lower 37 GHz sharing framework, we recommend using the established 70/80 GHz model as a baseline, but with band-specific adaptations. In the Third FNPRM the Commission seeks comment on using the Part 101 coordination model.²⁶ Indeed, the successful 70/80 GHz framework (where authorized “Database Managers”²⁷ operate a system of link registrations) exists within the Commission’s Part 101 rules, but with specific adaptations for the policy goals and operational aspects of the 70/80 GHz band. This streamlined system often results in links being approved in just a couple days. The sharing framework for the Lower 37 GHz band should follow

²⁶ Third FNPRM ¶64.

²⁷ This terminology is used by the Commission in WT Docket No. 02-146.

this template—namely, selectively draw from Part 101 rules to create a framework modeled after the 70/80 GHz regime’s streamlined and expeditious application and grant process.

We believe the record in the 70/80 GHz proceeding²⁸—specifically the 2003 Report and Order²⁹, the 2004 “Designation Order”³⁰ and taking into account the rule modifications from the 2005 Memorandum Opinion and Order³¹—provides an effective and detailed template from which to expeditiously create rules (noting that certain adjustments will be needed for the specifics of the lower 37 GHz band³²).

Generally we would expect that geographically proximate licensees (including both Federal and non-Federal) would negotiate in good faith, to coordinate their frequencies of operation, and submit the result into the license registration system. In such cases, the license registration system for the lower 37 band could operate similarly to the 70/80 GHz band, and expeditiously provide a “green light” or “yellow light,” following this submission.³³ However, with the goal of creating an innovation band, some

²⁸ Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands, WT Docket No. 02-146.

²⁹ *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands*, Report and Order, WT Docket 02-146, released Nov 4, 2003.

³⁰ *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands*, Order, WT Docket 02-146, released Sep 29, 2004.

³¹ *Allocations and Service Rules for the 71-76 GHz, 81-86 GHz, and 92-95 GHz Bands*, Memorandum Opinion and Order, WT Docket 02-146, released Mar 2, 2005.

³² One such adjustment is that the link registration system for the Lower 37 GHz band will also have to include a frequency coordination function since site licenses will be allocated by (one or more) 100 MHz channels. The use of site licenses is also a change from the 70/80 GHz framework which registered point-to-point links.

³³ In the 70/80 GHz band, a green light represents clearance from NTIA, that the proposed authorization does not negatively impact Federal operations, and does not violate certain other conditions e.g. is not located in a Quiet Zone or require environmental assessment. In the Lower 37 GHz band, a green light would similarly indicate authorization to deploy, but includes consideration of both Federal and non-Federal users proximate to the requested authorization. A yellow light indicates further information is necessary before authorization.

licensees may not have the resources for such negotiations with other licensees, and would prefer to hire a 3rd party. This should be permitted.

To the extent NTIA acts as a proxy for federal users, NTIA may wish to utilize an automated tool to keep track of its users for the purpose of facilitating new license coordination. Under co-equal status, Federal and non-Federal users would necessarily be subject to the same basic authorization and operational requirements. If Federal users are subject to materially different or open-ended or undefined requirements, sharing simply cannot be efficient or fair, and investments by non-Federal users cannot be made with confidence. We and other non-Federal entities with an interest in making this shared band a success, can only proceed on the assumption that the Federal use-cases will be substantially similar to, or not materially different from, the non-Federal use cases. With that assumption in mind, the only material difference in the sharing framework's operation (between Federal and non-Federal users) might be limited to the non-disclosure of protected Federal site details for certain Federal users. If the Commission and NTIA are not operating from this same set of assumptions, additional details are required in order for non-Federal interests to propose constructive recommendations on integrating the Federal and non-Federal coordination frameworks.

Accommodation rule. Federal and non-Federal users (hereafter referred to as “licensees”³⁴) should be required by rule to accommodate proposed next-in-time uses to the extent feasible, although the Commission should refrain from mandating particular outcomes from that accommodation process.

³⁴ Note that Federal users are not FCC licensees, but to achieve co-equality via a common sharing framework, some functional equivalence is needed. One potential means of achieving this is for NTIA or its agents to serve as a registration/licensing proxy, to “license” on behalf of federal agencies, thereby enabling non-federal coordination with federal users to proceed quickly.

For that reason, radios should be required to tune across the entire 600 MHz range.³⁵ Licensees should be encouraged to bargain to accept interference, swap operating frequencies, allow a prospective licensee to utilize blocks of spectrum not in use, or other technical means to accommodate subsequent users. This mechanism will encourage licensees to build systems sized to their requirements, and it will encourage indoor users (for example, industrial automation networks within a manufacturing facility) to take steps to ensure that if they want access to the entire 600 MHz band, their facility be designed or retrofitted in a way to sufficiently attenuate signals from leaving the facility and to attenuate outdoor signals coming into the facility.³⁶

³⁵ The Commission has imposed operability requirements (47 CFR 30.218) that would require radios to operate on all frequencies from 37-40 GHz. However, that requirement was put in place before the Lower 37 GHz band was adequately discussed in the record, and there were various lingering uncertainties on operational questions due to petitions for reconsideration, and the lack of a completed sharing framework. While this full-band operability is not burdensome for radios that will operate anywhere in the exclusively licensed bands above 37.6 GHz, certain categories of Lower 37 GHz band users will never use those exclusively license frequencies. Given the proposal to create an innovation band from 37-37.6 GHz, we believe it is in the public interest for the Commission to permit lower 37 GHz band equipment manufacturers to elect whether or not to support the frequencies above 37.6 GHz in their product line. Products dedicated to operation only in the Lower 37 GHz band may be offered at lower cost, and may be able to provide better isolation relative to the frequencies above 37.6 GHz, compared to equipment required to operate across the full band. In other words, equipment which will operate in the exclusive licensed 37.6-40 GHz range must be able to operate on all frequencies from 37-40 GHz, but in the likely smaller and more cost-sensitive market of equipment that would only operate in the non-exclusive 37-37.6 range, the Commission should consider permitting the option of only operating over that 37-37.6 GHz range.

³⁶ There could be an objection that a particular licensee is not following the accommodation rule in failing to accommodate when it is feasible to do so. While accommodation should occur in the context of private bargaining between a licensee and a prospective licensee, a prospective licensee, if spurned, should be able to proceed to the informal complaint process. This ensures that there is now an on-the-record report of the complainant's desire for spectrum, who the incumbent is, and whether the complaint was resolved to the complainant's satisfaction. An incumbent may wish to avoid the creation of such a record, and the very existence of a recourse to the informal complaint process could encourage private bargaining. Joint Commenters would caution the Commission against establishing a process where any aggrieved party could easily resort to the formal complaints process, which would drag down Commission resources. Licensees and applicants should be expected to accommodate each other where feasible, and if accommodation is not feasible, applicants should consider other options.

Accommodation rule example scenarios. There are likely some deployment scenarios where site polygons from different licensees (regardless of whether PZ or GS) overlap or cross. The accommodation rules would play an important role in resolving such cases. For example, Licensee A deploys a point-to-point link on the roof of three-story building A, aimed at three-story building C where it also has rights to deploy, but the signal must crossover the top of one-story building B that is in between buildings A and C. Thus, Licensee A's registered site polygon for its point-to-point link would cross over building B. If the owner of building B has not deployed a network (i.e. has not exercised its right to register and deploy via a PZ license), Licensee A has no licensee to coordinate with and should be permitted in principle to deploy such a network. However, Licensee A should design its network in a way that would allow it to readily accommodate the owner of building B deploying in the future, since (per the established rules in this band) the owner of building B has just as much right to deploy a network and expect non-interfering operation as Licensee A. This scenario also highlights the three-dimensionality of site license polygons—so long as distinct networks deployed by distinct licensees can coexist on a non-interfering basis, their polygon license areas can overlap. In this example case, presuming the overlapping polygons having sufficient spatial separation in three-dimensional space and other network parameters allow it, coexistence (perhaps even co-channel) is feasible and is enabled by the presence of licensee accommodation rules.

As another example, say building owner D obtains a PZ license for its property and deploys an indoor network for automation purposes, using all six available channels, and the emissions through the building walls meet the requirement at its property boundary. Later, adjacent building owner E seeks to deploy an outdoor network to serve its loading dock, but cannot meet the boundary emission requirement at its property boundary that abuts or overlaps the property of building owner D while still maintaining a high reliability network. Through negotiation, if building owner D is satisfied that the

excessive emissions from building E are sufficiently attenuated such that building D's indoor network performance is not impacted, building owner D can affirm acceptance of interference from building E, and building E can submit its registration and coordination details, noting the deviation in the filing record.

Finally, the Joint Commenters note that the objectives for this band are inconsistent with accommodating a blanket authorization for aeronautical or airborne use³⁷, and we would encourage the Commission to find other bands for such uses to the extent commenters propose them and an appropriate band does not already exist where such uses are permitted.

D. Federal users should not have priority or pre-emption privileges under the co-equal access rights established in this band.

In the Third NPRM,³⁸ the Commission asks for comment on granting priority use for Federal entities. Under the co-primary, co-equal access objective for the Lower 37 GHz band, Federal users should not have priority over non-Federal users, and Federal users should not be able to pre-empt non-Federal users. Indeed, there is little point developing a sharing framework under that co-equal umbrella if priority and/or pre-emption privileges for Federal users are designed in.³⁹ Perfect co-equality under all

³⁷ As the Commission notes in the Third FNPRM at footnote 216, aeronautical mobile service is excluded from the allocation for this band. NTIA is also opposed to airborne use (NPRM ¶148).

³⁸ Third FNPRM ¶168.

³⁹ There may be a select few cases where a waiver request for deviating from co-equality in access rights is justified. These waivers should be held to a high threshold of necessity, and should only be considered in cases where the impact to other users (Federal and non-Federal) can be contained on a sustained basis. Such waiver requests would likely be best handled by requiring joint agreement between the FCC and NTIA. There should be a well-defined and limited set of conditions where a waiver would be considered, and any request outside those conditions would be rejected. In such cases, the party seeking the waiver must simply use another band that already grants the user the superior protection and priority rights it seeks.

scenarios between Federal and non-Federal users is not likely achievable, but any outlier scenarios are expected to be rare, and can be handled on a case by case basis. Joint Commenters note that, under our proposal and including Property Zone licenses (described in later sections), Federal users on Federal land would have rights to Property Zone licenses, which can serve as *de facto* prioritized spectrum. In summary, the Commission should not designate any class(es) of Federal users with blanket prioritization and/or pre-emption rights.

E. Geographic configurations for site-licensing: general and property site licenses.

We propose two *categories* of site licenses, both defined by polygon license area boundaries, under this non-exclusive authorization in the Lower 37 GHz band:

- **General Site (GS) licenses** (a licensee-defined service-area polygon for all license requests that are not PZ license requests)
- **Property Zone (PZ) licenses** (a license with boundaries coinciding with real property boundaries, to include federal land).

These license category distinctions are primarily for administrative purposes. Both categories would gain access to spectrum via the same coordination framework. However, a distinction is that GS licenses could often be *geographically* shared due to overlapping service area polygons by multiple users (and thus have potential for co-channel interference, without proper frequency coordination), while PZ licenses are generally expected to be *geographically exclusive*⁴⁰ to each property owner since no other entity has access rights to deploy on the property without the permission of the property

⁴⁰ There are possible exceptions to this general expectation for PZ licenses. See the examples described in the Accommodation rule example scenarios sub-section, earlier.

owner. Since the frequency coordination effort should be easier for PZ licenses, it makes administrative sense for a PZ license to be a separate category of license.⁴¹

In consideration of the propagation characteristics and the rules already adopted for this band, we also observe that a real property owner can legitimately acquire a site license where they select their property boundary as the site license polygon boundary. The property boundary in effect defines the operational boundary of the site relative to other nearby licenses, and the PZ licensee would be required to meet emission limits at the property boundary polygon, for example, using power flux density (PFD) as is commonly used in other bands for defining license boundaries.

In the view of the Joint Commenters, a property zone license (to include federal property) is simply a subset of General Site licenses, and is used in cases where the licensee possesses property rights. No other party has access rights to the property, for network deployment or any other purpose, without the permission of the PZ licensee. Thus, there is no downside or disruption to other potential licensees in enabling the PZ license category, to see if demand develops, which we expect it will. While Joint Commenters are generally opposed to proposals for assigning spectrum licenses to specific user groups because such schemes generally exclude other user groups, a PZ license does not exclude any other *eligible* user groups for the reason noted above. Thus, the PZ license category is suited to facilitating the Commission's goal for this band of encouraging innovative deployment models and enabling new use cases.

⁴¹ Having a separate category of PZ license should also facilitate registration and coordination efforts for prospective future licensees (both GS and PZ) since the locations of properties that have activated a PZ license would be contained in the license registration system.

Some may draw parallels between the PZ license and the Commission's hybrid plan proposed in the initial NPRM. Such parallels are misdirected. Unlike the hybrid plan, these property licenses in the Lower 37 GHz band are not nested within exclusive licenses (under the lower 37 GHz band rules, there are no exclusive licenses), and therefore no prioritization or co-existence rules need to be developed relative to exclusive licensees, and no tiered sharing framework needs to be developed. Rather, in the lower 37 GHz band, the PZ licenses are simply an alternative administrative category of site license declared for the specific case of property owners. In addition to Federal entities deploying on Federal land, some examples of the types of eligible non-Federal entities for a Property Zone license (PZ) include: enterprise and industrial users, education facilities, health care facilities, event venues, and transportation hubs, to name a few.⁴²

F. Site license terms and anti-warehousing considerations.

To align with the license terms in the adjacent 37.6-40 GHz bands, the licenses in this band should be for a 10 year term with renewal expectancy. This alignment with adjacent bands may help spur demand from users in the upper bands

Warehousing of spectrum in a site-licensed band (noting that site licenses are substantially smaller than the large geographic area licenses where anti-warehousing rules are generally considered) is less likely to be a policy concern, particularly with the accommodation rule that requires licensees to accommodate other licensee's use of spectrum to the extent feasible. Moreover, one-size-fits-all build-

⁴² While a real property owner would be the only entity authorized for a PZ license, they may authorize a 3rd party to deploy, operate, and/or manage their network, *e.g.* a service provider.

out requirements are inconsistent with the diversity of networks likely to materialize in this band.⁴³

Networks are likely to range from very simple to highly complex. As a result, the Commission should simply declare that in the event warehousing of spectrum becomes an issue, it will apply a rule of reason to assess whether there was a timely use of the spectrum assigned.

In addition, the Commission should consider requiring licensees to check-in once a year in an automated way to validate that it is still using the spectrum assigned. If the check-in fails to occur, the Commission would issue a public notice listing the licenses at risk. At the expiration of a period following the public notice (e.g., 90 days), by rule the entity would need to cease operating and entities coordinating licenses could then disregard that license. The entity that put itself in jeopardy by not checking in would then have to coordinate anew to resume operation. This approach would serve double-duty as a mechanism to open up unused spectrum in situations where a licensee has abandoned the system but failed to turn in its license.

G. Application of the Part 30 rules

This section first discusses the RF characteristics of a PFD boundary limit for Property Zone licenses, to examine the viability of high-availability indoor use with minimal leakage outdoors. Next, we recommend that Section 30.8 of the Commission's rules should not be applied to the licensees in this band. We also discuss our view that any regulations for this band should be mindful of the ease of entry and low cost objectives.

⁴³ For example, population coverage metrics would not necessarily be applicable to machine-to-machine/IoT communications where one relevant measure is "things" rather than population.

Power Flux Density. Below we provide some initial details on the RF viability of Property Zone (PZ) licenses in the lower 37 GHz band.⁴⁴ As discussed earlier in this comment, the physics of millimeter waves provides important opportunities for allowing indoor private and industrial use – e.g., a manufacturing facility using networked automation capabilities or IoT devices for business-critical use that requires high-availability operating conditions. The walls of a building constructed of metal or brick are capable of providing appreciable isolation at these frequencies, and there exist commercial RF shielding materials for retrofitting less absorbing walls. However, there are other building elements which also must be considered in the overall signal leakage into and out of a building – e.g., roofs, building components that open and close (*e.g.*, doors, garage doors, windows), etc. As a point of reference, we note that the characteristic isolation level (penetration loss) for a well-engineered energy-efficient commercial building is in the neighborhood of 45dB⁴⁵. Thus we have used this building isolation level in our calculations below, as it appears to be consistent with an achievable and cost-effective value for commercial buildings. We also observe that this level of building isolation, together with the comparatively strong propagation losses in the 37 GHz region, allow for high-availability indoor use of wireless communications equipment with minimal leakage outdoors.

⁴⁴ Our PFD analysis focuses on PZ licenses because this is a new category of license, where the existing property boundary is linked to emission limits. GS license scenarios, on the other hand, are expected to include a wide range of outdoor clutter configurations, and site polygons that could overlap with multiple other licensees each having antenna, power level, network topology, and other technical differences that impact coexistence. While a PFD limit may be relevant for certain GS topologies, in general the GS licensees may need a greater degree of case-specific coordination of technical operating parameters with neighboring licensees to successfully address coexistence. It is important to note that these issues are a function of the non-exclusive co-equal site-licensing regime in this band, and are not specific to the GS and PZ categories we are proposing. In fact, the separate PZ category should help simplify the coordination for the portion of licensees electing the PZ license, particularly for indoor deployments.

⁴⁵ See for example ITU-R REC P.2019 at Figure 1.

If external co-channel signals penetrating inside a private or government building are comparable to or below the thermal noise levels, then the impact will more likely be acceptable as it allows a wide range of commercial wireless systems to operate successfully and reliably with close to their design capacities. Here we consider an example bandwidth of 100MHz, for which the thermal noise level is -93.9 dBm. If the threshold external interference level inside the building is 6 dB below thermal noise, and the building has an outside-to-inside penetration loss of 45dB, then the acceptable interference level on the outside of the building is -54.9 dBm. The power flux density (PFD) corresponding to -54.9 dBm on the outside of the building is then -74.9 dB(mW/m²/MHz). The reciprocal would also be true, *i.e.*, if the network inside the building imposed a power flux density of -54.9 dBm on the interior walls of the building, then the resultant interference leaking outside would be 6dB below thermal noise.⁴⁶

Note that we provide this PFD figure as a working, interim example, not as a fixed recommendation from the Joint Commenters on the specifications for this band. Further analysis of additional scenarios would be necessary before arriving at a final recommendation.⁴⁷ With that caveat in mind, we believe that this PFD represents a reasonable first approximation to the maximum interference that would allow reliable indoor use without imposing significant additional cost on private networks for additional building isolation. The presence of spatial separation between neighboring

⁴⁶ When a PFD is specified on a given surface in free space, it has the same numeric value independent of direction (in vs out). However, due to the presence of an absorbing wall, an additional subtlety enters which we briefly describe here. In the presence of an isolating surface (building walls) the PFD has the same numeric value if the outside-in PFD is measured on the outside of the building, and inside-out PFD is measured on the inside of the building.

⁴⁷ For example, one might define two different PFDs, one for co-channel signals (*i.e.*, for signals within the same channel being used within the license area) and a second PFD for adjacent channel signals. The adjacent channel PFD could be larger than the co-channel by an amount corresponding to representative adjacent channel selectivity values for the various relevant wireless technologies that may be deployed in the band.

networks (*i.e.* in many cases, buildings are offset from property boundaries) has the benefit of adding propagation path loss, which assists system isolation. At 37 GHz, even in the case of free space propagation, 60 meters of separation corresponds to ~100 dB of path loss.

Through separate analysis, we also observe that this PFD appears acceptable for the interference leaking outwards from the building, with what we assess to be reasonable indoor RF network design.⁴⁸ This PFD level would also allow for two private networks to successfully operate in adjacent buildings (whether the buildings are within the same PZ or in adjacent PZ licenses). For networks operating on adjacent floors in the same building, we believe such scenarios also permit reliable operations, either through use of adjacent channels and/or through the addition of additional isolation materials.

Section 30.8. While many aspects of the Part 30 rules retain their vitality with respect to the Lower 37 GHz band, there are a few that may be inappropriate due to the fundamental differences in the lower band. One such rule is the cybersecurity requirement contained in Section 30.8, which was written with service providers in mind. Given that the lower 37 GHz band is likely to be occupied by a wide variety of entities, the rule requiring a cybersecurity plan should not be applied to lower 37 GHz licensees. With respect to private entities, the Commission risks promulgating an approach inconsistent with Congressional directives or sector-specific regulations that are ordinarily beyond its purview. With respect to service providers using the band as an extension of the upper 37 GHz spectrum, those entities

⁴⁸ Our expectation is that indoor systems will operate well below the maximum 75 dBm/100 MHz EIRP permitted under the Part 30 rules for fixed and base stations.

will be following Section 30.8, and therefore the Commission’s interest in encouraging strong cybersecurity for service provider networks is fully preserved.

Ease of entry. Joint Commenters agree with the Commission that non-exclusive site licenses in support of an innovation band should feature “quick access to spectrum without unreasonable processing delays,”⁴⁹ to enable all types of band participants to offer services. Modest license fees will further this objective, and with respect to coordination, prospective licensees are likely to seek out a provider in the competitive market to provide coordination services for them.

Finally, the regulatory framework for this shared band is focused on enterprise/industrial, Federal, or service provider use. It is unlikely that consumer users would prosecute and maintain PZ licenses (much less GS licenses) due to the complexity of engineering a network, prior coordination, licensing, annual check-in, as well as the requirement to follow the accommodation rule.⁵⁰ As stated above, even enterprises deploying in the band are likely to use third party providers to coordinate and manage administrative matters related to licenses.

III. Conclusions

The Joint Commenters recommend a straightforward and streamlined sharing framework for the 37-37.6 GHz band, using the successful and well-established 70/80 GHz framework as a baseline,

⁴⁹ Third FNPRM ¶62.

⁵⁰ The 14 GHz of Part 15 unlicensed millimeter wave spectrum available in the 57-71 GHz band is well-suited to consumer applications and users.

and drawing from existing Part 101 rules where efficient. A complex, dynamic framework like the 3.5 GHz SAS is not necessary or applicable. Based on the licensing conditions set by the Report and Order (non-exclusive, site licenses), co-equal Federal and non-Federal users would access a common coordination framework to request and be granted a site license defined by a service-area polygon (which includes real property owners as a special administrative category), with no users having priority or pre-emption rights over other co-equal users.